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to incorporate in this one the new material that, as he tells us, he has prepared for a continuation of his discussion. This new material is to appear soon in another form; and, until it appears, we must postpone any detailed criticism in these columns of our author's known views. That the book contains much fair discussion of theories, and a very readable collection of facts, is plain enough; and, on the other hand, one need not dwell on the consideration, that, in their present form, these lectures cannot be considered as abreast with the advance of so rapidly growing a study as this. We shall add here only one criticism; namely, that there is, in this work, one obvious imperfection that has especially to do with our author's principal purpose itself. Professor Chadbourne studies instinct in animals that he may throw more light on the place and relations of instinct in man. But, just when he comes to speak of human nature, his psychological foundation is so antiquated, that all his learning helps us, his readers, but a little way. It is the old schematized and abstract psychology that is in his mind throughout, with its 'rational' and 'moral natures' of man, with its more or less complex scheme of subdivisions in each of these 'natures,' and with its notion of an abstractly defined hierarchy of human powers. For very elementary instruction, not in psychology as such, but in morals, this old psychology will still do well enough, no doubt, as a sort of rough working hypothesis; but the scheme is unreal, and modern psychology finds little use for it.

For this reason it is, that, when our author draws an elaborate parallel between the functions of the sense of obligation and those of the instincts, we feel that the undoubted actual likeness of these two sets of phenomena is distorted in his description, for the sake of fitting the facts to an *a priori* notion about the 'higher spiritual nature' of man. When he gives us an elaborate diagram, representing the place of the instincts among human faculties, we feel that this diagram represents a sort of stuffed soul, badly mounted, as it were, and no living soul of man at all. When, again, an argument for immortality peeps out from behind our author's classification of the belief in immortality as an instinctive human belief; when, in fact, we are told that one instinct ought to be as well founded as another, and that the belief in immortality is as much an instinct as is the instinct of an insect to lay eggs in autumn, — we feel only a sense of vexation that an ill-conducted analysis of human nature, accepted by our author from tradi-

tion, should be used by him for such a purpose in a scientific course of lectures. Why mix together utterly separate lines of consideration? Our belief in the real goodness of things, and in the worth of life, gains no whit, and can only lose force, by being confused with investigations into external physical phenomena, or even into the laws of the sequence of mental states. That tradition has long since sanctioned this confusion is no justification for it here.

#### RECENT TECHNICAL BOOKS.

CAIN's algebra contains two entirely distinct essays. In the first of them, with the hope of making the treatment of negative quantities clear to the student of elementary mathematics, the author represents real quantities in the usual way, — by lengths laid off upon a straight line, towards the right from a fixed origin on the line if the quantities are positive, towards the left if they are negative, — and develops successively the rules for algebraic addition, subtraction, multiplication, and division, by the help of this concrete conception. The rules thus obtained are then shown to be generally applicable to all problems, whether the difference between positive and negative quantities in them is one of opposition in direction or not; and the essay closes with some remarks on the generality of formulas of trigonometry and analytic geometry proved for a single case.

In the second essay, Professor Cain describes some methods common to all sciences of reasoning, compares and illustrates by examples the analytical and synthetical methods for the solution of problems, and finally discusses a few examples in finding the equation of loci, where some solutions are lost in the course of the work, or where some strange ones are introduced. The distance of the point  $P'$  from the point  $P$  seems to be written indifferently  $PP'$  or  $P'P$ . The little book would doubtless prove interesting and suggestive to any student

*symbolic algebra, or the algebra of algebraic numbers, together with critical notes on the methods of reasoning employed in geometry.* By Prof. W. CAIN, C.E. New York, Van Nostrand, 1884. (Van Nostrand's sc. ser., No. 73.) 131 p. 18°.

*Testing-machines: their history, construction, and use.* By ARTHUR V. ABBOTT. New York, Van Nostrand, 1884. (Van Nostrand's sc. ser., No. 74.) 190 p. 24°.

*stadia surveying: the theory of stadia measurements, accompanied by tables for the reduction of stadia field-observations.* By ARTHUR WINSLOW. New York, Van Nostrand, 1884. (Van Nostrand's sc. ser., No. 77.) 148 p. 24°.

*The steam-engine indicator, etc.* By W. B. LE VAN. New York, 1884. (Van Nostrand's sc. ser., No. 78.) 169 p. 24°.

of mathematics who would spend a couple of hours in perusing it.

The historical part of Abbott's 'Testing-machines' is very brief, and consists of little more than a catalogue of machines built and used in the United States before the war. The second part of the volume treats of the construction of testing-machines, and the appliances used with them. The author describes very fully and clearly the apparatus made by the Fairbanks company, and much more briefly the machines of Emery, Riehle Brothers, Gill, and Olsen. The remainder of the book relates to the use of the testing-machine, and will be found a convenient handbook of instruction for beginners. It points out certain precautions which must be taken before and during a test; speaks of the appearance of the fracture as an indication of quality; shows what effect is produced upon results by varying the size of the specimen, the time of making the test, or the temperature of the piece under examination; and gives several valuable tables.

The author has apparently been very fortunate in obtaining definite indications of the 'elastic limit' by a method which he describes on pp. 84 and 138. As shown on his diagrams facing p. 82, this limit is indicated by a sharp change in the direction of the 'stress strain' line, amounting to nearly 90°, shortly followed by a sudden return of the line to its original direction.

These two points of inflection, occurring so uniformly in an otherwise regular curve, would seem to point quite strongly to some peculiarity of his apparatus. Indeed, we should expect something of the sort in the use of a testing-machine driven at a constant speed, as soon as the test-piece begins to stretch faster than the rate of the machine. The apparent elastic limit obtained in this way would not depend wholly upon the material tested, but could be made to vary by changing the speed of testing.

Most of Winslow's little treatise on stadia surveying is occupied by tables,—first, of horizontal distances and differences of level, to be used in the reduction of stadia field-observations; and, second, of logarithms (to four places of decimals) of sines and tangents,—but is preceded by forty-two pages devoted to an exposition of the theory of stadia measurements. This brief explanatory part would have been more satisfactory if it had been revised after its appearance in *Van Nostrand's engineering magazine*, so as to obviate the criticism which appeared in the number of the same magazine for June of last year.

In that paper it is shown, by Mr. R. S. Woodward of the naval observatory, that the formula expressing the relation between conjugate distances and the principal focal length of a lens, or system of lenses, is exact if properly interpreted, and applies equally well to any combination of lenses; and that the ordinary formula for the stadia instrument, if properly understood, is exact, whatever may be the number, kind, or disposition of the telescope lenses, so long as they are properly centred. This criticism, however, does not affect Mr. Winslow's statement of the general principles of stadia practice, but really confirms our belief in the superiority of stadia measurement to ordinary chaining. The eight pages of tables, previously used on the geological survey of Pennsylvania for reduction of observations, we think will be found serviceable to engineers engaged in stadia work.

Le Van's little book was prepared originally as a series of articles for the *Mechanical engineer* of New-York City. It has now been revised, extended, and re-written to some extent, for publication in its present form. It is an elementary treatise upon the indicator, and evidently intended solely for the class of readers to which it was addressed at its first appearance,—to those "whose education," as its author says, "has been and must be rather in the engine-room than in the class-room." Its publication in the periodical for which it was prepared is not a matter for public criticism; nor, perhaps, would be its presentation in this later form, except for the fact that the excellent work of Porter, its reproduction with doubtful propriety by an American editor and publisher, and the issue of the work of Mr. Pray (another 'expert' of unquestionable practical experience and skill), have hardly left a place for it. It lacks the precision of the first, and the thoroughly practical character of the other.

We find no satisfactory description of the familiar forms of instrument in the book. The introductory part contains a misleading calculation of the gain in fuel by expansion, showing an increase of economy which is never reached in the best of engines, and never even approximated in ordinary forms of the motor. The explanation of the indicator diagram, and the method of working it up, will be useful, and will be most carefully studied by the readers for whom the book is prepared. The fact that its author is thoroughly familiar, by practical use, with the instrument which he describes, is evident throughout; and this will probably aid in securing for it a sale.